RUSKIN USER GUIDE

Datalogger Manual

RBR

rbr-global.com

Revision History

Revision No.	Release Date	Notes
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1.1	April 16, 2010	Updated to include sections for N-Point Calibration and Metatables
1.3	June 25, 2010	Include .tide and .wave information for TWR Include Rinko calibration note
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Warranty Statement

All data loggers manufactured by RBR Ltd. since September 2002, are warranted against defects in workmanship or original parts and materials for life.

Units suffering from such defects will be repaired or replaced at the discretion of RBR Ltd., provided that the problem has appeared during normal use of the instrument for the purpose intended by us. The liability of RBR Ltd. extends only to the replacement cost of the instrument. The customer will bear all costs of shipment to us for repair; all other costs, including return shipment, will be borne by RBR Ltd.

This warranty does not cover consumables or normal wear and tear, nor does it cover damage caused by negligent use or mishandling. Attempted modification or repair of any unit without the prior consent of RBR Ltd. will immediately void any warranty in force.

Users are expected to maintain a regular program of calibration. Equipment, such as sensors made by other companies, is warranted only to the extent provided by the original manufacturers.

We reserve the right to grant or refuse warranty repairs at our discretion if we consider that there are reasonable grounds for doing so.

Introduction

Ruskin User Guide

The Ruskin User Guide introduces you to Ruskin and helps you to use it effectively from the start.

The guide shows you the overall processes that we suggest you use. The process includes links to step-by-step procedures that are easy to follow. The guide also provides some conceptual information. Because we assume that you will use this guide while you are using Ruskin, the guide does not tell you what you can see for yourself in the Ruskin window.

You can access the Ruskin User Guide on the CD provided when you purchase a logger, from the Help menu in Ruskin, and on the RBR web site (www.rbr-global.com).

Release notes are automatically displayed each time you install an updated version of Ruskin. The most recent release notes are also available from the Help menu in Ruskin.

For information about operating and maintaining the RBR submersible data loggers, see the RBR Submersible Logger Hardware section of this manual (p. 44). It will tell you how to change the battery, inspect and replace O-rings, and so on.

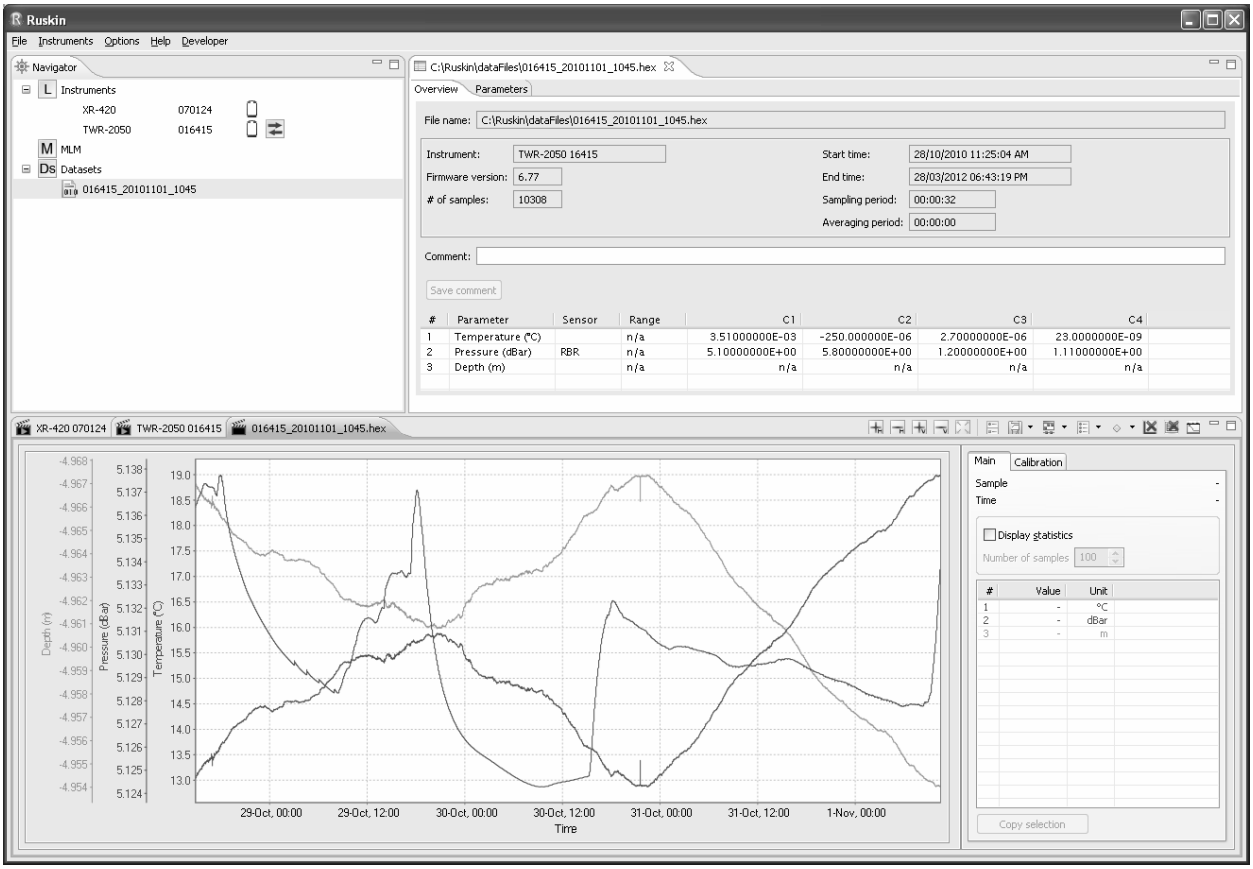
Ruskin

Ruskin is the RBR software that manages your RBR loggers so they provide all the data necessary to do your work. Ruskin provides a graphical user interface that makes using the loggers easy. Use Ruskin to do the following:

- configure, schedule and enable multiple loggers
- download data after logging
- graphically view data sets
- export data in various formats
- change the calibration coefficients for your logger

Ruskin can be used on Microsoft Windows (XP and Vista), and on the Apple Mac running OS X (10.5 Leopard or later).

Note: Your logger must be running RBR firmware version 6.2 or later to use this version of Ruskin. That equates to all instruments manufactured after January 1st, 2008.



Provide your feedback

As you use Ruskin to manage your RBR loggers, you may have questions or issues that are not addressed in this guide. At such times, we would like to hear from you.

Steps

1. From the Help menu, click Comment on Ruskin.
2. The Feedback to RBR dialog box appears.
3. Identify yourself and summarize your comments.
4. Provide a detailed description and add any attachments, if required.
5. Click OK.

We will respond to you using the email address that you provide.

Installation

Install Ruskin on a PC

You can install Ruskin on a Windows computer that uses the XP or Vista operating system.

Steps

1. Place the CD-ROM in the appropriate computer drive.
2. If the installation does not begin automatically, double-click the executable file named Ruskin Complete Setup in the root directory on the CD-ROM.
3. Follow the installation instructions. You can specify a different name and location for the working directory for the software, which is C:\Program Files\RBRRuskin by default.

A shortcut to Ruskin appears on the Desktop and in the Start menu folder called "RBRRuskin".

Install Ruskin on a Mac

You can install Ruskin on the Apple Mac running OS X (10.5 Leopard or later).

Steps

1. Place the CD-ROM in the appropriate computer drive.
2. After the CD-ROM mounts, open the drive and double-click the Ruskin package.
3. Follow the installation instructions. Although you can specify a different folder for the working directory for the software, we recommend that you use the default Applications folder.

A folder named "RBRRuskin" appears in the Applications folder.

Uninstall Ruskin

If you no longer need to manage RBR loggers from your computer, you can uninstall Ruskin.

Note: The uninstall utility does not delete any Ruskin data files or log files.

It is not necessary to uninstall an older version of Ruskin before installing a newer version. The installation program deletes the older files before installing the newer ones. For more information, see on page 5.

Windows XP

On the Control Panel, use the Add/Remove utility and click Ruskin.

Windows Vista

On the Control Panel Home, under Programs, click Uninstall a program, and then click Ruskin.

Macintosh computer

Move the RBRRuskin folder from Applications to the Trash.

Update Ruskin

To take advantage of new features and bug fixes, ensure that you are using the most recent version of Ruskin.

It is not necessary to uninstall an older version of Ruskin before installing a newer version. The installation program deletes the older files before installing the newer ones. It does not delete any Ruskin data files or log files.

The most recent version of Ruskin is always available on the RBR web site (www.rbr-global.com/). However, if you already have an older version of Ruskin installed, Ruskin automatically notifies you that a newer version is available when you start Ruskin. If you have a broadband connection, we recommend that you follow the installation instructions that appear on your computer. Otherwise, request a CD from RBR.

Configuration and Scheduling

Getting started with Ruskin

Before you begin using your RBR loggers, you may want to experiment a bit with the simulated loggers that are included in Ruskin. For more information, see "Stop logging" on page 7.

When you are ready to use your own RBR loggers, we recommend that you follow the following steps to ensure that you measure exactly what you want on the first attempt.

You must already have installed the Ruskin on a Windows computer or on a Macintosh computer.

Steps

1. If you are using your first logger, you can either use the default preferences or specify your preferences to apply to all your loggers. For more information, see "Preferences" on page 35. You can change these preferences at any time.
2. Connect your logger locally through your computer's serial port or USB to serial adapter. The logger should appear in the Navigator view after a few seconds.
3. Click the logger that you want to use. Ensure that it contains the sensors that you expect by viewing the **Information** tab in the Properties view on the right side of the Ruskin window. For more information, see "View information about a logger" on page 8.
4. If you want to see live data sampled every few seconds but not saved, select the start live plot button in the upper right corner of the Plot view, which is at the bottom of the Ruskin window.
5. Click the **Setup/Basic Configuration** tab to specify features such as streaming, averaging, and thresholding.

   Important: You must specify your preferences regarding these features before you enable the schedule. For more information, see "Configure a logger" on page 9.

   Note: These features are not available for all types of loggers. In fact, much of the configuration for the TWR-2050 logger, which records waves, is different from the other logger types. For more information, see "Configure a TWR-2050 logger" on page 13.

6. If you want to view or modify calibration coefficients, click the **Calibration** tab. For more information, see "Configure a logger" on page 9.

   Important: The conductivity, temperature, and depth sensors were calibrated to their specified accuracy before shipment, traceable to NIST standards. We strongly recommend that you consult RBR before changing any of these calibration coefficients.

7. Click the **Setup/Schedule** tab to schedule the logger to take samples when and as often as you want within the limits of your logger. For more information, see "Schedule a logger" on page 16.

   Ruskin prevents you from enabling a schedule that exceeds the memory capacity of the logger. Ruskin also shows the estimated battery usage (based on 1000 mAh cells) required to use your logger as scheduled. You should seriously consider this information before you enable the schedule.

8. On the **Setup** tab, click **Enable** to take samples according to the schedule that you specified. If you enabled streaming data, you can use the live plot mode button in the Plot view to choose whether to view samples taken at the default speed for your logger type (Fetching mode) or samples taken at the speed that you specified in the Sampling period box (Streaming mode) (Properties view/Schedule tab).

   Important: If you are streaming data and did not select the Enable data storage whilst streaming data check box on the Setup/Basic Configuration tab, the streamed data is not stored in the logger memory.

9. If you want to download data, click the **Download** tab to download all the data saved since your schedule was enabled. For more information, see "Download data to a file" on page 19. The focus changes to the new dataset in the Navigator view, and the static data appears in the Plot view. You can now export the downloaded data to a file in Excel, Matlab, engineering text, or raw text formats. You can also save the image as a PDF or PNG file for viewing outside Ruskin.

Stop logging

Logging stops on its own when one of the following occurs:
- The end logging time is reached.
- The power is removed.
- The logger memory is filled.
- The logger battery is depleted.

You can also stop logging at any time by doing the following:
- On the **Setup** tab (Properties view), click **Stop**.

Important: Whether or not you make any changes to the schedule or the configuration before running the schedule again, a warning appears that the contents of memory will be erased. If you want to save the data stored so far on the logger, you must download the data to a file (Download tab/Download button) before proceeding.

Use a simulated logger

Ruskin can simulate most logger types that RBR produces. We recommend that you experiment with your type of simulated logger before enabling a schedule for your actual RBR logger. This practice will probably save you time in the long run.

Steps

1. From the **Instruments** menu, click **Simulate instrument**. The Configure Simulated Instrument dialog box appears.
2. Under Logger type, click the logger type that you want to simulate. Under Logger channels, the types of logger channels on that simulated logger are selected.
3. If you chose one of the XR logger types, do the following:
   - Under Logger channels, select any additional channels that you want the simulated logger to have.
   - If you selected any channels for which the Auto-ranging check box is available, consider enabling the Auto-ranging feature. An auto-ranging sensor automatically adjusts its gain setting to the best measurement range to display the quantity being measured.
4. Under Options, choose the options that you want for your simulated logger:
   - If you want a visual indication that a logger is running, select the **Sampling LED** check box.
   - If you want to view live the data samples that you schedule, select the **Streaming** check box.
   - If you want the logger to convert raw data to printable ASCII characters in an engineering format before transmitting it, select the **Engineering units output** check box.
5. Click **OK**. The simulated logger appears under Instruments in the Navigator view.
6. Click the new simulated logger. You can work with this logger the same way as you work with a real RBR logger, including configuring and calibrating it, and logging and downloading data. For more information, see “Getting started with Ruskin” on page 6.

Multiple loggers, both real and simulated, can be listed in your Navigator view.

Tip: If you want to remove a simulated logger, right-click it and click **Remove simulated instrument**. You can also use the Instruments menu.

View information about a logger

You can view static information about a logger at any time as follows:

- In the Navigator view, click the logger that you want. The Information tab in the Properties view on the right side of the Ruskin window identifies the logger and the kind of sensors on its channels.

Note: This is the only tab in the Properties view that you can access without any battery consumption, as indicated by the absence of a battery icon.

Configure a logger

Before you enable a logger schedule, you can configure the logger to suit your requirements.

The instructions to configure a TWR-2050 logger, which measures waves, are different.

If your logger schedule is already enabled when you decide to change the configuration, you must stop running the schedule, make your changes, and enable the schedule again. However, any data stored so far on the logger will be lost.

Tip: You can preserve the data by downloading it to a file before you enable the schedule again.

You can click Revert settings at any time. Note that this action resets the settings on both the Setup/Basic Configuration tab and the Setup/Schedule tab to those settings used the last time you enabled the schedule for this logger.

Note: Whenever the Setup tab is in focus, the battery is being used as indicated by the battery icon on the tab and the animated battery icon in the Navigator view. You can click the Information tab to save power.

For any XR logger with an external power connector, the logger can be set to start logging automatically on power-up. The logger sets the time to 2000/Jan/01 00:00:00 on power-up, and starts logging at 2000/Jan/01 00:00:10. The end time is set to 2004/Jan/01 and the sampling period that you previously set is used until the power is removed, you stop the logger, or the memory is full, assuming data storage was not inhibited. If your logger supports this feature, you can activate it by selecting the Enable streaming data check box on the Setup/Basic Configuration tab.

Steps

1. While the logger you want is highlighted in the Navigator view, click the Setup/Basic Configuration tab in the Properties view.

   If any settings are not available for your logger, they are grayed out.

2. If you want to connect another instrument to the deployed logger to “listen” to the logger and take action under certain conditions or while still connected to the logger you want to view a graphical display of the live data samples taken according to your schedule, select the Enable streaming data check box. We recommend that you also select the Enable data storage whilst streaming data check box so that the data will not be lost.

   Note: Your logger may not support this feature.

   For more information, see “Fetching and streaming data” on page 18.

3. If you want your logger to convert raw data to printable ASCII characters in an engineering format before transmitting it, select the Enable engineering units output check box.

   Note: Although the data stored on the logger is of the highest precision, some precision may be lost if you use the data in the Plot view because Ruskin converts the data back to the raw format.

4. If you can see your logger case while it is deployed and want a visual indication that the logger is running, select the Enable sampling LED check box. This LED does consume battery power.

   The LED will flash when sampling and can be seen through the Delrin© housing.

   Note: Your logger may not support this feature; this feature is found on XR and XRX series loggers.

5. If you want to use the average of multiple readings rather than take a single reading for each sensor in a sampling period, select the Enable averaging check box and specify the averaging duration. The averaging duration must be shorter than the sampling period. For more information, see "Averaging" on page 11.

   Notes: 1. Your logger may not support this feature. 2. When you use the thresholding option, averaging cannot be enabled. 3. Only the averaged value is stored.

6. If you will be profiling while the logger schedule is enabled, select the Enable 6Hz profiling check box.

   Data is collected at six samples per second, and the Sampling period on the Schedule tab is disabled.

   Note: Your logger may not support this feature.

7. If you want to store readings from all your sensors whenever the reading for a particular sensor reaches a specific threshold, do the following:

   - Select the **Enable thresholding** check box. For information about thresholding, see "Thresholding and hysteresis" on page 11

   - Click the type of sensor in your logger that you want to monitor.

   - Type the threshold value and indicate whether this is the upper limit (<) or lower limit (>) of your threshold.

   - Specify how often you want the monitored sensor to be checked. Checking less frequently will preserve battery power because all the sensors on the logger are turned off between checks.

- If you want to specify a maximum time during which the logger can continue to store samples while the thresholding condition is no longer met, select the Enable hysteresis check box and specify the time period. Note that Ruskin enforces a hysteresis period that is a multiple of your sampling period (Schedule tab). For more information, see "Hysteresis" on page 12.

Notes: 1. Your logger may not support thresholding and hysteresis. 2. When you use the thresholding option, averaging cannot be enabled.

Averaging

You can enable averaging of sensor readings when configuring a logger (Properties view/Setup/Basic Configuration tab or Waves tab). Averaging can give you better statistics because although extreme readings are included in the averaged readings, they do not attract undeserved attention.

The averaging duration must be smaller than the value specified for the sampling period (Schedule tab). The tidal averaging duration must be smaller than the value specified for the tidal sampling period (Setup/Waves tab). These requirements exist because averaging is done on all the readings taken during the averaging period, which begins at the start of the next sampling period.

For example, if your sampling period is five seconds and you want to average the readings over three seconds, the following happens during each five-second period:

1. For the first three seconds, readings are taken from each sensor on your logger and at the end of the three seconds; the average value is computed and stored for each sensor.

2. For the next two seconds, no readings are taken.

Thresholding and Hysteresis

You can enable thresholding when configuring a logger (Properties view/Setup/Basic Configuration tab). By thresholding, you avoid storing data when conditions are not of interest to you. This option saves the battery and consumes less memory. It is typically used when profiling.

When a specified periodic check by the logger shows that the threshold that you specified is reached, the logger starts recording samples at the frequency specified by the sampling period (Properties view/Setup/Schedule tab). The logger continues recording samples until the threshold is no longer maintained.

For example, a logger is programmed to check every 10 seconds whether the temperature sensor registers less than 20°C and, if so, to take readings from all the sensors every two seconds. Here is what happens:

Time lapsed (seconds)	Temperature	Logger action
10	20.9°C	Reads temperature and then waits 10 seconds
20	19.8°C	Reads temperature and then begins storing all sensor values every 2 seconds
42	20.1°C	Reads temperature and then waits 10 seconds
52	20.5°C	Reads temperature and then waits 10 seconds

Note: When you use the thresholding option, averaging cannot be enabled.

Hysteresis

Hysteresis can be enabled only when you also enable thresholding (Properties view/Setup/Basic Configuration tab). The hysteresis option lets you specify the maximum time that the logger will continue to store samples while the thresholding condition is no longer met. After that time lapses, samples are not stored until the next time the logger checks for the thresholding condition and finds that it is met.

Note that Ruskin enforces an hysteresis period that is a multiple of your sampling period. If you change the value of your sampling period, the hysteresis value changes to the same value.

Hysteresis is often used when splashing or wave action is a factor. For example, you program your logger to take readings only when it is in contact with the water. You use the thresholding option to check every six seconds whether there is contact. Because the wave action changes the height of the water surface, the logger fluctuates upon deployment between being in and out of the water. By enabling an hysteresis value of ten seconds, your logger continues to store samples while not contacting the water for up to ten seconds at a time.

Time lapsed (seconds)	Water contact	Logger action
1-5	Yes	Stores samples because threshold is met
6-10	No	Stores samples due to hysteresis option
11-13	Yes	Stores samples because threshold is met
14-23	No	Stores samples due to hysteresis option
24	No	Checks for threshold and suspends storing samples
25-30	Unknown	Waits before checking whether threshold is met
31	No	Checks for threshold
32-37	Unknown	Waits before checking whether threshold is met
38-60	Yes	Resumes storing samples

Configure a tide and wave recording (TWR-2050) logger

Before you enable a TWR-2050 logger, you can configure it to better suit your requirements. This type of logger records data for tides and waves, and its configuration is different from that of the other RBR loggers. For information about configuring the other loggers, see “Configure a logger” on page 9.

If your logger is already logging data when you decide to change the configuration, you must stop logging, make your changes, and start logging again. However, any data stored so far on the logger will be lost.

Tip: You can preserve the data by downloading it to a file before you restart the logger.

You can click “Revert settings” at any time. Note that this action will revert the settings on any of the Setup sub tabs to those settings used the last time you enabled the schedule for this logger.

Note: Whenever the Setup tab is in focus, the battery is being used as indicated by the battery icon on the tab and the animated battery icon in the Navigator view. You can click the Information tab to save power.

Steps

1. While the logger you want is highlighted in the Navigator view, click the **Setup/Basic Configuration** tab in the Properties view.

2. If you want to connect another instrument to the deployed logger to “listen” to the logger and take action under certain conditions, or while still connected to the logger you want to view a graphical display of the live data samples taken according to your schedule, select the **Enable streaming data** check box. We recommend that you also select the **Enable data storage** whilst streaming check box so that the data will not be lost.

   For more information, see “Fetching and streaming data” on page 18.

3. If you want your logger to convert raw data to printable ASCII characters in an engineering format before transmitting it, select the **Enable engineering units output** check box.

   Note: Although the data stored on the logger is of the highest precision, some precision may be lost if you use the data in the Plot view because Ruskin converts the data back to the raw format.

4. If you can see your logger case while it is deployed and want a visual indication that the logger is running, select the **Enable sampling LED** check box. This LED does consume battery power.

   The LED will flash when sampling.

   Note: Your logger may not support this feature.

5. Under the **Setup/Waves** tab, in the **Tidal sampling period** box, specify the interval that you want between samples.

   Note: If you change this value, any value in the Wave sampling period box changes automatically so that it remains the same number of multiples of this value. For more information, see “Relationship between the tidal and wave sampling periods” on page 15.

6. If you want to use the average of multiple readings rather than take a single reading for each sensor for a tidal sampling period, do the following:

   - Select the **Enable tidal averaging** check box.

   - Specify the tidal averaging duration. The tidal averaging duration must be shorter than the tidal sampling period. For more information, see “Averaging” on page 11.

   - Specify the rate in Hz at which you want to take tidal samples.

Note: If you select the Enable wave measurements check box, this rate also applies to the rate at which wave samples are taken.

7. If you want to take samples of wave bursts, do the following:

    - Select the **Enable wave measurements** check box.

    - In the **Wave sampling period** box, specify the interval that you want between taking readings of wave bursts. This value must be a multiple of the value specified in the Tidal sampling period box. For more information, see "Relationship between the tidal and wave sampling periods" on page 15.

    - In the **Burst length of the wave** box, click the number of samples that you want to take during a wave burst.

    - In the **Altitude of instrument (m)** box, type the number of metres above seabed or river bed where the logger will be secured in place.

      This value is used when making wave calculations.

    - Estimate the mean depth of water in metres.

      This value helps predict the range of wave frequencies that can be measured. In particular, read-only values for wave analysis bandwidth and wave periods will appear. Ruskin will calculate the actual depth from the measured pressure data post-deployment.

You can now schedule your logger.

Relationship between the tidal and wave sampling periods

The wave sampling period must be a multiple of the tidal sampling period. Changing the wave sampling period changes the relationship between the two values because the wave sampling period becomes a different number of multiples of the tidal sampling period. This number of multiples is maintained if you then change the tidal sampling period.

Here is an example that you can try:

1. If you set the tide sampling period to 5 seconds, then, set the wave sampling period to 20 seconds (4 multiples of 5).

2. Now change the wave sampling period to 30 seconds (6 multiples of 5).

3. Finally, change the tidal sampling period to 10 seconds.

   To maintain the new relationship of 6 multiples, the wave sampling period will change automatically to 60 (6 multiples of 10).

Note: Within a wave burst measurement the tide can be sampled up to four times.

Schedule a logger

You can schedule your loggers to start and stop taking readings when you want and at the sampling rate you specify for the sampling period. Ruskin indicates any unattainable conditions in the defined schedule at the bottom of the Schedule tab, and the Enable button is grayed out.

You can select Revert settings at any time to set the previous schedule. Note that this action reverts back to the settings (on both the Setup/Schedule tab and the Setup/Basic Configuration tab) used the last time that you ran the schedule for the logger.

Before you schedule your logger, you should be satisfied with the global preferences (Options menu/Preferences dialog box) and with the configuration settings for your logger (Properties view/Setup/Basic Configuration tab or Waves tab). For information, see "Configure a logger" on page 9 or "Configure a TWR-2050 logger" on page 13.

Note: Whenever the Setup/Schedule tab is in focus, the battery is being used as indicated by the battery icon on the tab and the animated battery icon in the Navigator view. You should display the Information tab to save power.

Steps

1. While the logger you want is highlighted in the Navigator view, click the Setup/Schedule tab in the Properties view.

2. Click **Synch to PC**.

3. In the **Enable** boxes, specify the date and time that you want to start running the schedule or select the **Immediately** check box.

   Tip: If you select and then clear the **Immediately** check box, you can then manually modify the current date and time instead of the original values.

4. Choose whether to specify an end time or to take samples as long as possible:

   - To specify an end time, in the **End logging** boxes, specify the date and time that you want logging to stop.

   - To continue logging as long as possible, click **Maximize logging duration**.

     The values in the End logging boxes change to the latest date and time possible, given the available memory and the specified sampling period.

5. Choose whether to specify the interval between samples or to take samples as often as possible:

- To specify the interval that you want between samples, use the **Sampling period** box.

  Note: An error message appears at the bottom of the Schedule tab if the sampling period is too fast for your logger.

- To take readings as often as possible, click **Maximize sampling speed**.

  The value in the Sampling period box changes to the shortest period possible, given the available memory, the specified logging duration, and the minimum sampling period for your logger.

Note: For the TWR-2050 logger, which measures waves, the Sampling period box and the Maximize sampling speed button are not available because this kind of information is specified on the Setup/Waves tab.

6. If your logger uses the RS-485 serial protocol, select the **Assume RS-485 when calculating battery usage** check box.

   Because the RS-485 serial protocol draws additional battery power, this information is included in the calculations of battery usage.

7. Note the estimated battery capacity that is required to enable your logger as scheduled. Ruskin estimates how long your battery will last using battery capacities of 1000 mAh. Actual battery life is affected by your battery capacity and the temperature during deployment.

   If the battery bar indicator is orange instead of green, you can still start logging, but the logger stops if the battery is depleted before the specified end logging time.

   Tip: If the battery bar indicator is green but shows that you are close to capacity and you know that your logger will be operating under very cold conditions, you may want to lower the demands on the battery. You can either shorten your logging duration or lengthen your sampling period.

8. Note the actual memory required to use your logger as scheduled. Ruskin prevents you from running a schedule that exceeds memory capacity. If your schedule requires excessive memory, the memory bar indicator is red rather than green, and the Enable button is grayed out.

   Tip: You can either shorten your logging duration or lengthen your sampling period.

9. Click Enable.

   The schedule runs within 10 seconds.

   Tip: If the Enable button is grayed out, an error message appears.

Realtime data

Fetching and streaming data

The speed at which a logger takes readings and what it does with those readings depend on whether the schedule is enabled and whether streaming data is also enabled.

Enabled without streaming

You can enable a schedule without enabling streaming. The logger takes readings as scheduled at the speed specified in the Sampling period box. This data is stored and can be downloaded.

If you are still connected to the logger, you can click the start live plot button in the Plot view. A graphical display appears of the samples fetched from the logger at the default speed for the logger type rather than of the samples that are scheduled and being stored on the logger.

Enabled with streaming

You can enable a schedule with streaming enabled. The logger takes samples as scheduled at the speed specified in the Sampling period box. This data is stored and can be downloaded only if you also enabled data storage.

The streaming option lets you connect another instrument to the deployed logger to “listen” to the logger and take action under certain conditions. For example, when a temperature reading exceeds 30 degrees Celsius, the connected instrument makes a call to you.

In the Plot view, if you are still connected to the logger, you can click the live plot mode button and select Streaming, and then click the start live plot mode button. A graphical display appears of the readings being taken at the speed specified in the Sampling period box. **However, if any tab other than the Information tab is active, the flow of live data pauses until you click the Information tab.**

If you want to view a graphical display of the readings being taken at the default speed for your logger type, select the Fetching mode instead of the Streaming mode.

Not enabled

When a schedule is not enabled, the logger does nothing by default. However, if you are still connected to the logger, you can click the start live plot button in the Plot view. The logger immediately begins fetching samples at the default speed for your logger type, and a graphical display of the live data appears. The data is not saved on the logger and therefore cannot be downloaded.

Download

Download data to a file

You can download data from a logger at any time. If you stop running a schedule, you must download the data before you restart the schedule to prevent the data stored so far from being lost.

Note: Whenever the Download tab is in focus, the battery is being used as indicated by the battery icon on the tab and the animated battery icon in the Navigator view. You can click the Information tab to save power.

Steps

1. If you think that the connection to the logger will be at a low baud rate, perhaps due to a long cable, select the **Slow Connection** check box. Otherwise, Ruskin automatically increases the connection speed to the maximum possible during the download.

   If the connection speed used is too fast for your environment, the connection may fail with a message.

2. If you want to add notes that will be stored with the downloaded data, add them in the Comment box.

   Your comment will be visible on both the Overview and Source tabs (Properties view) for the resulting dataset. You can modify or add to this comment on the Overview tab.

3. Click Download.

   The Save as HEX dialog box appears.

4. Specify a location and a name for the data file.

   By default, the hex file name uses the Ruskin file naming convention.

The name of the new dataset appears and is highlighted automatically under Datasets in the Navigator view. The Properties view changes to the new dataset and contains the Overview and Source tabs. All the data that was stored on the logger at the time of the download is automatically plotted in the Plot view.

Note: Downloading data again while the same schedule continues to run picks up the same data plus any data stored since the last download.

File naming convention

In Ruskin, by default, the name of a data file is composed of the following information:

- The first six digits represent the logger serial number.
- The next eight digits represent the current year, month, and day.
- The next four digits represent the current time to the minute.
- The file extension indicates the file format and should not be changed. If you change it, the file extension that you specify becomes part of the name, and the required extension is appended.

For example, the file named 911936_20090522_1613.hex contains data for a logger with a serial number of 911936 whose data was downloaded in 2009 on May 22 at 4:13 p.m.

View, analyse, and export

Open a stored dataset

You can open any stored dataset to explore its contents.

Steps

1. From the File menu, click Open dataset and double-click the hex file that contains the data that you want to view, or you can click one of the recently opened datasets shown in the menu.

   The name of the dataset appears and is highlighted automatically in the Navigator view. The Properties view changes to the dataset. Its Overview tab shows information about the logger that generated the data, the schedule that was run, and the number of samples represented in the data. The data in the file is automatically plotted in the Plot view.

2. If you want to store a comment with the dataset or modify any comment that you added when you downloaded the data, use the Comment box.

   Tip: To close a dataset, right-click its name in the Navigator view and click Close dataset.

The Plot view

You can use the Plot view to view a graphical display of either static data in datasets or live data. When viewing live data, the logger must still be attached.

A toolbar at the top of the Plot view contains various buttons to help you customize, explore, and export the graphical display.

Each channel appears as a different colour in the graphical display. These colours are specified for all graphical displays in the Plotting section of the Preferences dialog box (Options menu/Preferences) and can be changed only there. You can also change other defaults affecting the Plot view in the Preferences dialog box. For information, see ”Specify plotting preferences” on page 36.

Tabular panel

You can click a particular time in the plot to view each channel value and related statistics at that time. A vertical black line marks the place. The tabular panel on the right shows those values, the last value read for each channel, the sample number, and the time that the data was read.

For datasets only, you can select the Display Statistics check box to view the average value and standard deviation for each channel based on the number of samples that you specify. The number of samples must not be greater than the number of the current sample, which appears in the upper-right corner.

For a TWR-2050 dataset, you can select the **Show waves** check box to view a plot that shows the height of waves.

If you want to copy the data to the clipboard and then paste it into another application, click **Copy**. Note that the column headings are not included.

Datasets

Use the Plot view to view a graphical display of static data in a dataset.

The graphical display for each dataset appears on its own tab in the Plot view. The dataset file name appears at the top of the tab. Note that the icons differentiate at a glance the live data from the datasets.

Tip: If a graphical display does not appear, click the line style button and ensure that either **Draw lines** or **Draw markers** is selected.

Live data

You can use the Plot view to view a graphical display of samples being fetched at the default speed for your logger type. If you enabled streaming, you can also view samples taken according to your schedule. In either case, the logger must still be attached. For a discussion of fetching and streaming, see “Fetching and streaming data” on page 18.

The graphical display for live data for each logger appears on its own tab in the Plot view. The logger model and serial number appear at the top of the tab. Note that the icons differentiate at a glance the live data from the datasets.

Tip: If a graphical display does not appear, click the start or resume live plot button. If the graphical display still does not appear, click the line style button and ensure that either Draw lines or Draw markers is selected.

Zoom tools for datasets and live data

Purpose	Button	How to use
Compress or expand data horizontally	Horizontal zoom out Horizontal zoom in	Click the button each time you want to further compress or expand the data horizontally. The expansion or contraction is centered around the vertical black line in the plot. If no line exists, the focus is in the centre. **Tip**: To place or move a vertical black line, click the time in the plot on which you want to focus.
Compress or expand data vertically	Vertical zoom out Vertical zoom in	Click the button each time you want to further compress or expand the data vertically.
Undo the last zoom	Undo zoom	Click the button to undo the last zoom in or out. You can do this as many times as you zoomed.
Return to the original view	Reset zoom	Click the button to return to the original view of the graphical display.

Other tools for datasets and live data

Purpose	Button	How to use
Show or hide a legend in the plot	Show legend/Hide legend	Click this button to toggle between showing and hiding a legend at the bottom of the plot.
Save an image of the graphical display to a file	Export plot	Click the button and then specify a file type (PDF or PNG), location, and name for the file that will contain an image of the graphical display currently in the Plot view. For more information, see "Save a plot for viewing outside Ruskin" **Tip**: If you want the legend to be included, first click the show legend button.
Show lines or markers for each channel	Line style	Click the button and then click **Draw lines**, **Draw markers**, or both. If you click neither, no graphical display appears in the Plot view.
Show or hide particular channels or raw data	Show/hide channels	Click the button and select which channels to show in the Plot view. You can choose to show or hide specific channels used by your logger, or all the channels of a particular type, such as measured, derived, depth, or temperature. **Tip**: If you want to view the uncalibrated data for measured channels in the form of a voltage ratio instead of as engineering units, select **Toggle raw channels**.
Show events and errors in the graphical display	Display any dataset events or errors	If the icon on the button is yellow, click the button and select **Display dataset events** or **Display dataset errors** or both. A green icon indicates no events. Refer to appendix C for a description of the events and errors. Dataset events appear on the x-axis as a vertical gray line with a stamp to indicate the type of event, such as STP for a stop event in a dataset.
Show or hide axes	Show/hide axes	Click the button to toggle between showing and hiding the vertical axes to the left of the plot.

Show or hide data panel	Show/hide data panel	Click the button to toggle between showing and hiding the data panel to the right of the plot.
Minimize the Plot view	Minimize	Click the button to place the Plot view as an unopened view in the margin of the Ruskin window. **Tip**: To restore the Plot view to its former size, click the restore button in the margin.
Maximize the Plot view	Maximize	Click the button to expand the Plot view to the full size of the Ruskin window. **Tip**: To restore the Plot view to its former size, click the Restore button in any margin that contains an unopened view.

Tools only for datasets

Purpose	**Button**	**How to use**
Place the depth channel on the y-axis	Depth plot	Click the button to reorganize the graphical display so that the depth channel becomes the vertical, or y-axis, and all other channels are plotted along the horizontal, or x-axis. Tip: Click the maximize button to more easily view the graphical display.

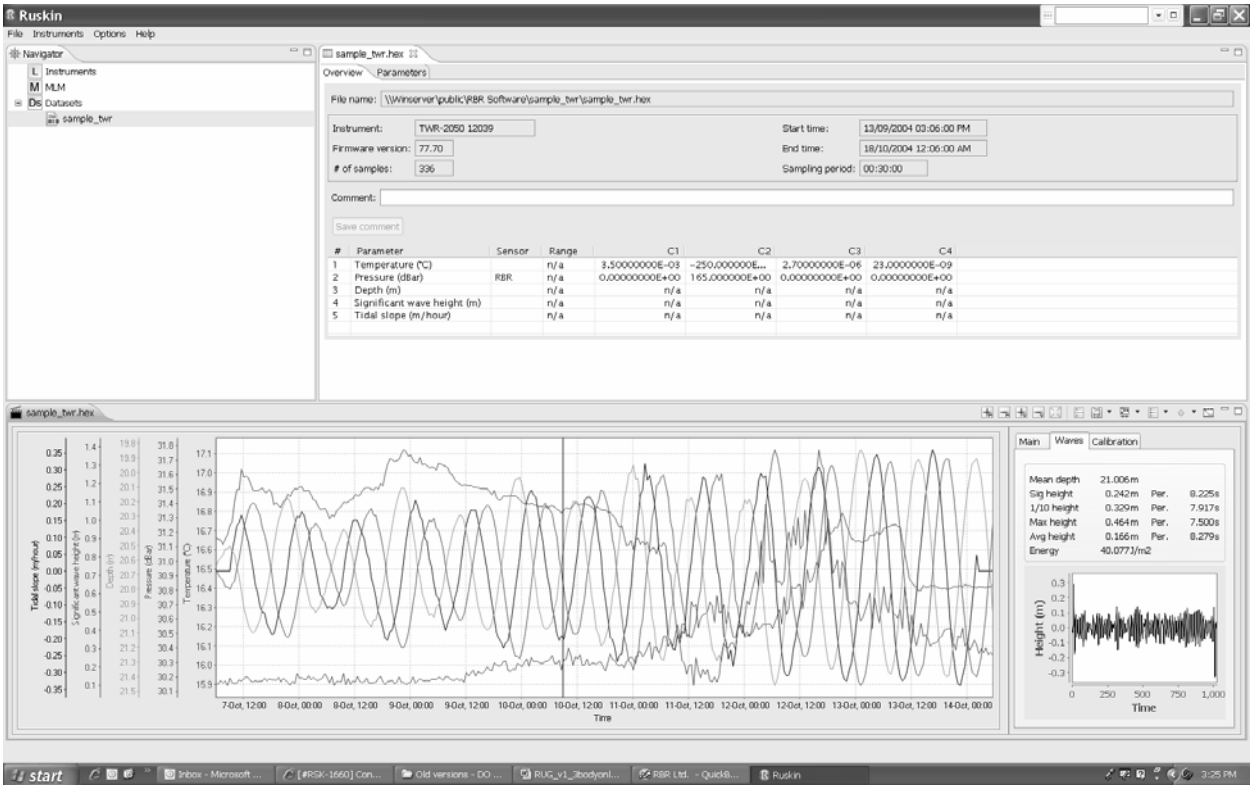
Tools only for live data

Purpose	Button	How to use
Toggle between fetching samples at the default speed and viewing streamed data	Live plot mode	Click the button and then click **Streaming** or **Fetching**. You can select the streaming mode only if you are currently logging data and you selected Enable streaming data (Properties view/Setup/Basic Configuration tab or Waves tab). **Note**: If any tab other than the Information tab is active in the Properties view, any streamed data flow is suspended. **Tip**: When switching from one live plot mode to the other, first click the **suspend live plot** button then choose the other live plot mode, and finally click the resume live plot button.

Start, stop, or restart the flow of data in the Plot view	Start live plot/Suspend live plot/Resume live plot	Click the button to start, stop, or restart the flow of data in the Plot view. If you click the **Suspend live plot** button, the graphical display is frozen. If you click the **Resume live plot** button, the flow of current data resumes. **Note**: In the Plot view, data is not recorded during the time that the live plot is suspended. However, data continues to be stored on the logger as scheduled.
Delete the data in the Plot view	Clear plot	Click the button if you want to delete all the data in the Plot view for all channels. **Note**: Any data stored on the logger is preserved.

Tide and Wave Display

When data has been downloaded from a TWR-2050P recorder that contains wave information, three derived units are always calculated: depth, significant wave height (WavHt) (which corresponds to H1/3 in meters), and tidal slope (TSlope) (m/hour). These parameters can be seen graphically in the **Plot** view, while clicking on the **Waves** tab to the right of the Plot view will show a summary of the derived units. Selecting a particular wave burst on the main plot display will show the calculated parameters for that burst in the Wave tab.



Export data

You may want to share your data with others or analyze your data using other software. You can export data as a text file, which can then be imported into many applications, or for analysis in Microsoft Excel or The MathWorks Matlab.

You must already have downloaded the data to a dataset or opened an existing dataset.

Steps

1. Right-click the dataset whose data you want to export, and click Export as, or use the File menu.

2. Choose the type of file that you want to create:

    - To work with your data in Excel or Matlab, click the respective name.

    - To work with your data in a text file, click **Engineering text txt**.

    - To work with your raw data in a text file, click **Raw text txt**.

    - To work with your wave information from a TWR-2050 in a text file, click **TWR wave**.

- To work with your tide information from a TWR-2050, click **TWR tide**.

3. Specify a location and a name for the data file.

   By default, the file name is that of the dataset with the appropriate file extension.

4. Click **Save**.

Save a plot for viewing outside Ruskin

You may want to share a plot with others, include its image in a document, or print it.

Steps

1. In the Navigator view, click the dataset or logger whose plot you want to save.

2. In the Plot view, click the export plot button and specify a file type (PDF or PNG) for the file that will contain an image of the graphical display currently in the Plot view.

3. Specify a location and a name for the plot.

   By default, the location is the one specified in the Directory for data files box (Options menu/Preferences dialog box/General). You can change the location for this file, which will also change the default location.

   By default, the file name for a dataset plot is that of the dataset with the appropriate file extension. The default file name for a plot showing live data follows the Ruskin file naming convention.

4. Click **Save**.

Calibration

Change calibration coefficients

You can view the calibration coefficients that were entered when your logger was last calibrated. You can change these calibration coefficients by typing directly into the table cells or by pasting a row or table of coefficients from an external source, such as a spreadsheet.

Note: Whenever the Calibration tab is in focus, the battery is being used as indicated by the battery icon on the tab and the animated battery icon in the Navigator view. You can click the Information tab to save power.

Important: The conductivity, temperature, and depth sensors were calibrated to their specified accuracy before shipment, traceable to NIST standards. We strongly recommend that you consult RBR before changing any of these calibration coefficients.

Steps

1. While the logger you want is highlighted in the Navigator view, click the Calibration tab in the Properties view.

   The current values for the coefficients appear.

   Tip: To view the previous set of coefficient values for the logger, scroll to the bottom of the Calibration tab and click **Retrieve previous episode**. To view all previous sets of coefficient values, click **Retrieve all episodes**. You may want to click the maximize button **show button**for the Properties view.

2. Choose how you want to make your changes.

Goal	**Action**
To change calibration coefficients directly in Ruskin	Click each value once, type a different value, and press Enter.
To copy out an entire row or the entire table **Note**: Individual columns of data cannot be copied.	If copying a single row, highlight the row in the table and then click **Copy from selected row**. If copying the entire table, click **Copy table**.
To paste data for an entire row or the entire table	If pasting a single row, highlight the row whose data you are changing and then click **Paste to selected row**. If pasting an entire table, click **Paste table**.

   Tip: Until you store the calibration values, you can restore the original coefficient values in the table at any time by clicking **Revert calibration**.

3. After you finish making all the changes that you want, click **Store calibration** to write the coefficients into the logger memory.

N-Point Calibration

RBR data loggers use several types of sensors that generate a voltage output that is proportional to the value of the parameter being measured. Ruskin will allow N-point calibration of these sensors, specifically dissolved oxygen measured by an Oxyguard sensor, pH, turbidity and depth in a TGR-1050HT. Ruskin can be used to easily generate

the appropriate calibration coefficients based on the data generated during calibration measurements.

Oxyguard DO Calibration

The Oxyguard DO sensor has relatively stable performance, and it can be calibrated with a single-point calibration technique using a reading at 100% oxygen concentration only. The 100% calibration should be performed at the expected temperature and salinity of the deployment environment.

Equipment

1. Large mouth beaker with a volume of not less than 2 litres
2. Aquarium air pump
3. Magnetic stirrer

Steps

1. Program the logger to sample at a fairly fast rate (between 6Hz and 3 seconds). Use Sync to PC to ensure the logger clock is synchronized to the PC clock, and ensure the end time is set so that the logger will keep sampling until calibration is complete.

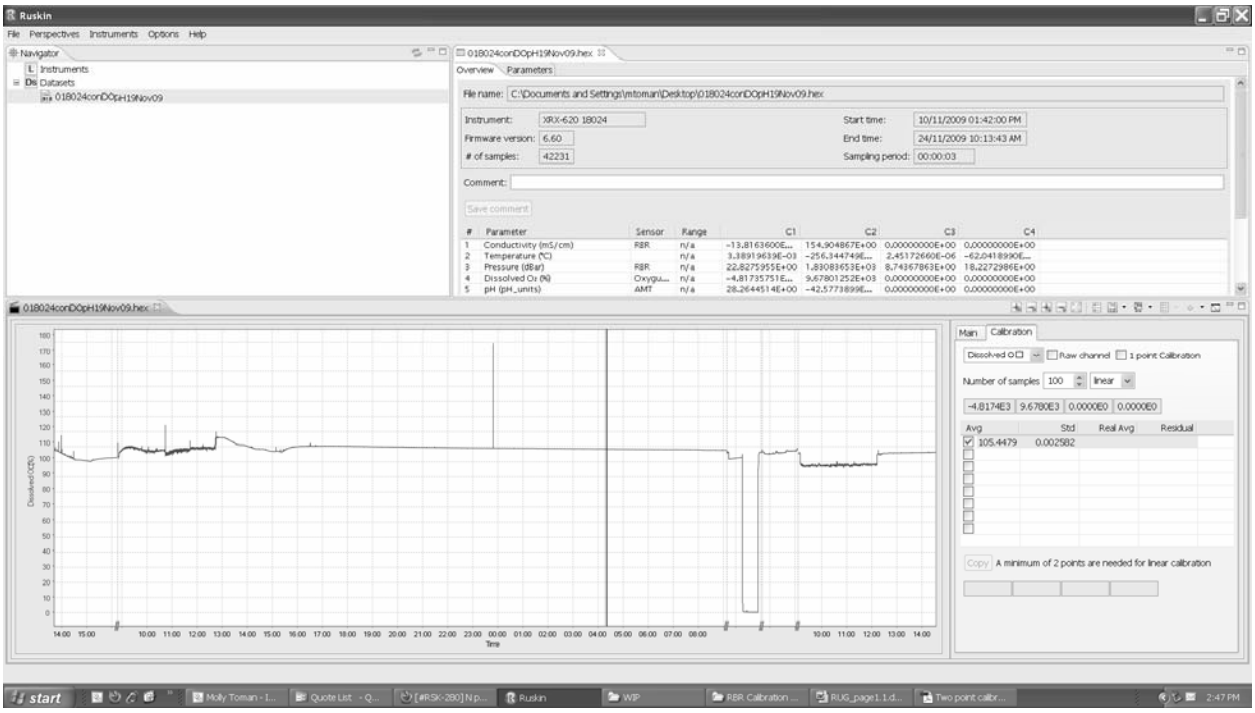
2. Fill the beaker with water and install the magnetic stirrer, ensuring that the stirrer is turned on. Bubble air through the water using the air pump.

3. Submerge the dissolved oxygen sensor near the stirrer to ensure that it is in a well-mixed area of the bath.

4. Take sample readings for at least 15 minutes for the 100% calibration point, making note of the time that the sample is being measured.

5. Retrieve the data from the data logger as per the steps in the “Download” section on page 19 of this manual. Make sure that a copy of the data is saved as well.

6. The calibration data should now be displayed in the Plot view. Click the Calibration tab in the Properties view to the right of the Plot view.


Ruskin
File Perspectives Instruments Options Help
Navigator
Instruments
Datasets
018024conDOpH19Nov09
Overview Parameters
File name: C:\Documents and Settings\mtoman\Desktop\018024conDOpH19Nov09.hex
Instrument: XRX-620 18024
Firmware version: 6.60
# of samples: 42231
Start time: 10/11/2009 01:42:00 PM
End time: 24/11/2009 10:13:43 AM
Sampling period: 00:00:03
Comment:
Save comment
Parameter Sensor Range C1 C2 C3 C4
1 Conductivity (mS/cm) RBR n/a -13.8163600E... 154.904867E+00 0.00000000E+00 0.00000000E+00
2 Temperature (°C) n/a 3.38919639E-03 -256.344749E... 2.45172660E-06 -62.0418990E...
3 Pressure (dBar) RBR n/a 22.8275955E+00 1.83083653E+03 8.74367863E+00 18.2272986E+00
4 Dissolved O2 (%) Oxygu... n/a -4.81735751E... 9.67801252E+03 0.00000000E+00 0.00000000E+00
5 pH (pH_units) AMT n/a 28.2644514E+00 -42.5773899E... 0.00000000E+00 0.00000000E+00
Main Calibration
Dissolved O2 Raw channel 1 point Calibration
Number of samples 100 linear
-4.8174E3 9.6780E3 0.0000E0 0.0000E0
Avg Std Real Avg Residual
105.4479 0.002582
Copy A minimum of 2 points are needed for linear calibration
Time
start
2:47 PM

7. Select the dissolved oxygen sensor type from the drop-down menu. If the data logger has multiple sensors, the Plot view will automatically update to only show the channel being calibrated. For the dissolved oxygen sensor, the 1 point calibration option should be selected.

8. The Number of Samples field is automatically set to 100 samples. This value is the number of sample points Ruskin will use to calculate the calibration coefficients for the sensor. Typically, this value will be in the range of 50 to 100 samples.

9. Click on a stable point in the Plot view corresponding to 100% oxygen. The Calibration tab will now show the average value and standard deviation for the range of samples set in Step 7.

10. Click in the Real Avg field in the Calibration tab and select the value 100 (for 100% oxygen) from the drop-down menu. Ruskin will automatically calculate the calibration coefficients, and the values will appear in the four boxes at the bottom on the Calibration view. Clicking the Copy button will save the new calibration coefficients to the clipboard.

11. Follow the steps in Change calibration coefficients on page 27 to update the calibration in the data logger.

AMT pH Calibration

Calibration of the pH sensor should use two or more pH buffers, and should be carried out every day that the electrode is used for optimum accuracy. It is recommended that a pH 7 buffer be

used to check the zero point and an acid and an alkaline buffer used to set the slope. RBR uses pH 4 and pH 10 to measure the slope.

Steps

1. Program the logger to sample at a fairly fast rate (between 6Hz and 3 seconds). Use Sync to PC to ensure the logger clock is synchronized to the PC clock, and ensure the end time is set so that the logger will keep sampling until calibration is complete.

2. Place the probe into buffer solutions of values 4, 7 and 10 for approximately 10 minutes in each solution. Remember to make note of the time for each of the sample points so that the correct data can be used to determine the calibration coefficients.

   Note: Ensure that the pH sensor is rinsed with clean water between each sample reading to avoid contamination between buffer values.

3. Retrieve the data from the data logger as per the steps in the “Download” section on page 19 of this manual. Make sure that a copy of the data is saved as well.

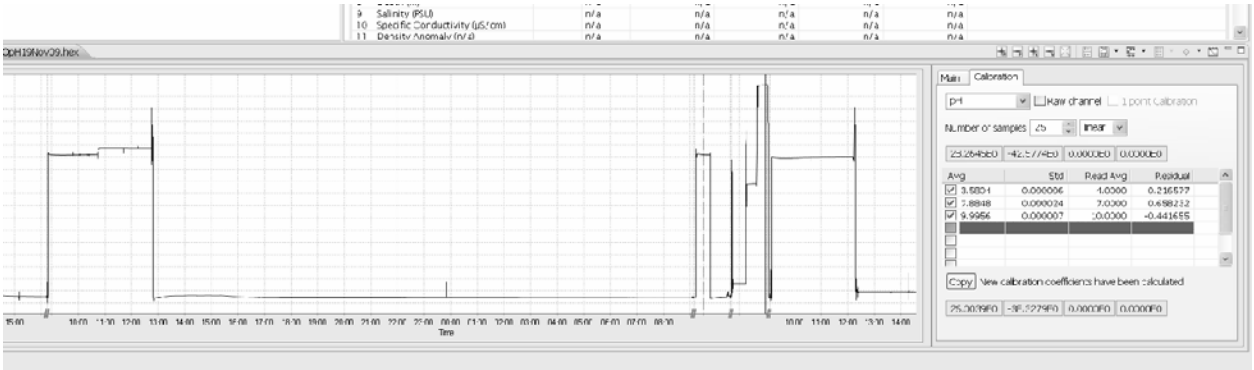
4. The calibration data should now be displayed in the Plot view. Click the Calibration tab in the Properties view to the right of the Plot view.

5. Select the pH sensor type from the drop-down menu. If the data logger has multiple sensors, the Plot view will automatically update to only show the channel being calibrated.

6. The Number of Samples field is automatically set to 100 samples. This value is the number of sample points Ruskin will use to calculate the calibration coefficients for the sensor. For the pH sensor, this value will typically be 25 samples.

7. To set the first point in the slope measurement, click on a stable point in the Plot view towards the end of the measurement in the pH 4 solution. The Calibration tab will now show the average value and standard deviation for this data point. Then click on the Real Avg box and enter the actual value of the buffer, in this case 4.

8. Repeat Step 7 for the pH 7 and pH 10 points, ensuring that you first select the next line in the calibration tab for the calibration point.



9. Ruskin will automatically calculate the calibration coefficients, and the values will appear in the four boxes at the bottom on the Calibration view. Clicking the Copy button will save the new calibration coefficients to the clipboard.

10. Follow the steps in Change calibration coefficients on page 27 to update the calibration in the data logger.

Seapoint Turbidity Calibration

The Seapoint turbidity sensor is calibrated with a two-point calibration technique. The calibration should be performed under fluorescent lighting.

Equipment

1. 4000-FTU Formazin standard – 100ml
2. Distilled water – 8 litres
3. Black-walled, wide-mouth container ($I.D._{min}$=300mm, $Height_{min}$=200mm)
4. Volumetric flask 1000ml, class A
5. Volumetric flask 100ml, class A
6. Stir stick

Steps

1. Program the datalogger to sample using a 10 second sampling interval. Use Sync to PC to ensure the logger clock is synchronized to the PC clock, and ensure the end time is set so that the logger will keep sampling until calibration is complete.

2. Flush the sensor, container and glassware with distilled water and dry them.

3. Fill the black wall container with 8000ml distilled water using the large volumetric flask.

4. Set the sensor in the container until the sensor is fully submerged in the distilled water.

Note: The distance from the sensor's windows to the container wall must be at least 20 cm. If possible, place a dark cover on the calibration container and avoid direct light on the container.

5. Record the data in distilled water for 5 min. This is the zero-turbidity calibration point.

6. Fill the 100ml volumetric flask with Formazin Standard. Remember to gently shake the bottle before opening the Formazin solution.

7. Add 100ml Formazin Standard to the black wall container with distilled water, and gently mix solution with a stirring stick.

8. Calculate value of the standard turbidity solution at calibration point according to following formula:

$$Tu_{STD} = Tu_{STK} * V_{TOT} / (V_{DW} + V_{TOT}) = 49.38 \text{ FTU}$$

Where:

Tu_{STD} = turbidity of the standard solution (FTU)

Tu_{STK} = 4000FTU – turbidity of the stock solution

V_{TOT} = 100 ml volume of stock solution at calibration point (ml)

V_{DW} = 8000ml - initial volume of distilled water

Note: By using this formula and changing the volume of distilled water and Formazin solution, you can prepare different calibration points for checking linearity of the turbidity sensor or getting close to real turbidity value of standard turbidity solution.

9. After 5 minutes, remove the logger from the calibration container and wash the sensor head under regular tap water.

10. Retrieve the data from the data logger as per the steps in the “Download” section on page 19 of this manual. Make sure that a copy of the data is saved as well.

11. The calibration data should now be displayed in the Plot view. Click the Calibration tab in the Properties view to the right of the Plot view.

12. Select the Tu sensor type from the drop-down menu. If the data logger has multiple sensors, the Plot view will automatically update to only show the channel being calibrated.

13. For the turbidity sensor, the Number of Samples field should be set to 25 samples.

14. Click on a stable point in the Plot view corresponding to the zero-turbidity calibration point.

15. Click in the Real Avg field in the Calibration tab and enter the value 0.

16. Repeat steps 14 and 15 for the Formazin solution readings, entering the value calculated in step 8 for the Real Avg field.

17. Follow the steps in Change calibration coefficients on page 27 to update the calibration in the data logger.

HT Druck Pressure Sensor Calibration

The TGR-1050HT and TWR-2050HT both use an atmospheric compensated Druck pressure sensor that can be calibrated by the end user using a two-point calibration method. Please note that this procedure is only for HT units, and does not apply to the pressure sensor used in the single and multi-channel data logger instruments.

Steps

1. Program the datalogger to sample using a 10 second sampling interval. Use Sync to PC to ensure the logger clock is synchronized to the PC clock, and ensure the end time is set so that the logger will keep sampling until calibration is complete.

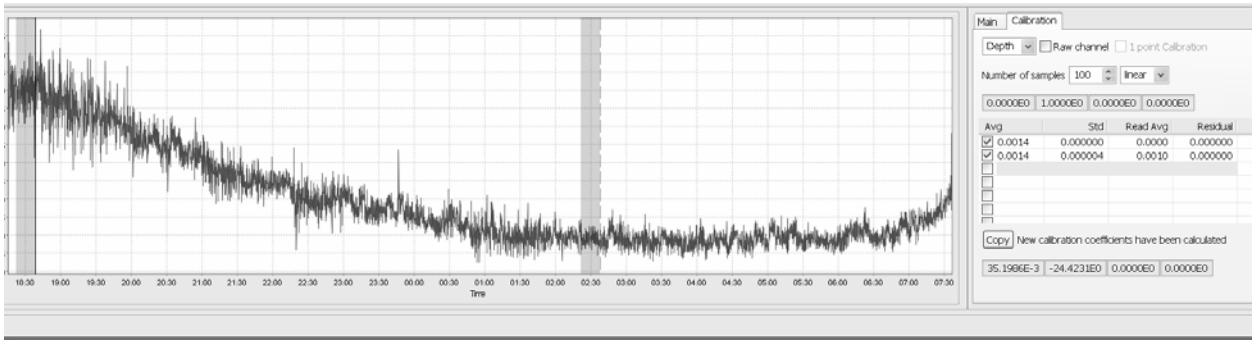
2. Hold the depth sensor out of the water for a period of approximately 5 minutes. This will be the zero depth point for the calibration.

3. Immerse the depth sensor to a known depth for 5 minutes. This set of readings will be the “at-depth” value.

4. Retrieve the data from the data logger as per the steps in the “Download” section on page 19 of this manual. Make sure that a copy of the data is saved as well.

5. The calibration data should now be displayed in the Plot view. Click the Calibration tab in the Properties view to the right of the Plot view.

6. Select the Depth sensor type from the drop-down menu.

6. 

7. The Number of Samples field is automatically set to 100 samples. This value is the number of sample points Ruskin will use to calculate the calibration coefficients for the sensor. For the depth sensor, this value should be set to 20 to 25 samples.

8. To set the first point for the two-point calibration, click on a stable point in the Plot view corresponding to your zero depth point from step 2.. The Calibration tab will now show the average value and standard deviation for this data point. Then click on the Real Avg box and enter the value 0.

9. Repeat step 8 for your “at-depth” value, entering the known depth range into the Real Avg box.

10. Follow the steps in Change calibration coefficients on page 27 to update the calibration in the data logger.

Alec Rinko Optode Calibration

The Rinko Optode **cannot** be calibrated using Ruskin N-point calibration. The required calibration procedure is documented in the application note “User Calibration for RINKO oxygen sensor” in Appendix C of this manual. Once the calibration is complete and the new coefficients for G and H have been calibrated, you will need to upload these values into your data logger using the Ruskin software.

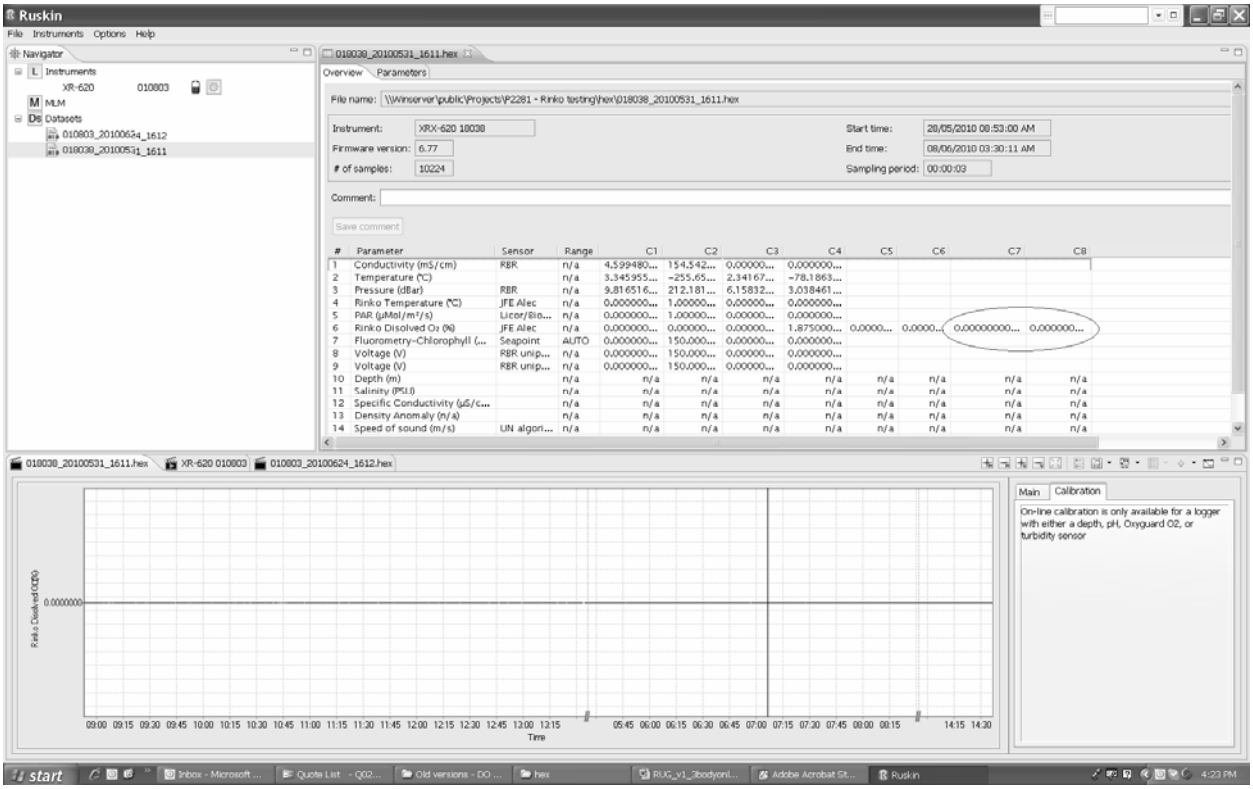
Steps

1. With the logger connected to your computer and Ruskin open, click on the Calibration tab in the Properties view.

2. You will notice that the calibration coefficients in the table are in the form of C1, C2, C3, etc. The calibration application note from Rinko uses A, B, C…H as the coefficient references. The calculated coefficient for G will be entered into the table under C7, while H will be entered under C8.

3. Please note that you should not modify any of the other coefficients for the Rinko (i.e. C1 to C6).

4. Follow the steps in Change calibration coefficients on page 27 to update the calibration in the data logger.


Ruskin
File Instruments Options Help
Navigator
Instruments
XR-620 010803
MLM
Datasets
010803_20100624_1612
018038_20100531_1611
Overview Parameters
File name: \\Winserver\public\Projects\P2281 - Rinko testing\hex\018038_20100531_1611.hex
Instrument: XRX-620 18038
Firmware version: 6.77
# of samples: 10224
Start time: 28/05/2010 08:53:00 AM
End time: 08/06/2010 03:30:11 AM
Sampling period: 00:00:03
Comment:
Save comment
Parameter Sensor Range C1 C2 C3 C4 C5 C6 C7 C8
1 Conductivity (mS/cm) RBR n/a 4.599480... 154.542... 0.000000... 0.000000...
2 Temperature (°C) n/a 3.345955... -255.65... 2.34167... -78.1863...
3 Pressure (dBar) RBR n/a 9.816516... 212.181... 6.15832... 3.038461...
4 Rinko Temperature (°C) JFE Alec n/a 0.000000... 1.00000... 0.000000... 0.000000...
5 PAR (µMol/m²/s) Licor/Bio... n/a 0.000000... 1.00000... 0.000000... 0.000000...
6 Rinko Disolved O2 (%) JFE Alec n/a 0.000000... 0.000000... 0.000000... 1.875000... 0.0000... 0.0000... 0.000000000... 0.000000...
7 Fluorometry-Chlorophyll (... Seapoint AUTO 0.000000... 150.000... 0.000000... 0.000000...
8 Voltage (V) RBR unip... n/a 0.000000... 150.000... 0.000000... 0.000000...
9 Voltage (V) RBR unip... n/a 0.000000... 150.000... 0.000000... 0.000000...
10 Depth (m) n/a n/a n/a n/a n/a n/a n/a n/a n/a
11 Salinity (PSU) n/a n/a n/a n/a n/a n/a n/a n/a n/a
12 Specific Conductivity (µS/c... n/a n/a n/a n/a n/a n/a n/a n/a n/a
13 Density Anomaly (n/a) n/a n/a n/a n/a n/a n/a n/a n/a n/a
14 Speed of sound (m/s) UN algori... n/a n/a n/a n/a n/a n/a n/a n/a n/a
018038_20100531_1611.hex XR-620 010803 010803_20100624_1612.hex
Main Calibration
On-line calibration is only available for a logger with either a depth, pH, Oxyguard O2, or turbidity sensor
Time
start
4:23 PM

Preferences

Ruskin sets global preferences that require no changes in many situations. However, as you learn more about what Ruskin can do, you may want to change some of these defaults to better suit your requirements. The global preferences include

- where to store output files
- plotting preferences
- adding depth as a derived channel
- adding derived channels related to conductivity
- adding dissolved oxygen as a derived channel
- calculating derived channels when sensors are missing

You can change these preferences at any time.

Specify directories for log files

You can control where log files are stored by default. Specify these locations before downloading any data.

Steps

1. From the Options menu, click **Preferences**.

2. In the list on the left side of the Preferences dialog box, click **General**.

3. In the Directory for log files box, type a directory name or click **Browse** to locate the directory where you want to store log files.

   Note: Log files are used when you request RBR support.

4. Click **Apply** or **OK**.

You can change where future log files are stored by default at any time. The change takes effect immediately.

Specify plotting preferences

You can specify how you want the graphical display in the Plot view to behave by default. With the exception of choosing colours for each channel, these preferences can be overridden for a particular graphical display in the Plot view.

Tip: You can click Apply to save your changes without closing the dialog box.

Steps

1. From the Options menu, click **Preferences**.

2. In the list on the left side of the Preferences dialog box, click **Plotting**.

3. Specify whether you want to hide by default any measured channels that are used only to create derived channels.

   For example, you may want to hide the pressure channel used to determine depth. Viewing both sets of values adds nothing because they are mirror images of each other. Hiding this pressure channel in a plot does not also hide a pressure channel used to measure pressure for its own sake.

4. Specify whether you want to show events by default in the Plot view.

   Events appear at the x-axis as a vertical gray line with brief text to indicate the type of event, such as STP for a stop event in a dataset. Refer to appendix C for a list of the event types.

5. Specify whether you want to show errors by default in the Plot view.

6. Click each channel number and specify the colour that you want it to be in the Plot view. Choose a selection of colours that are easy to see and differentiate.

7. Click **OK**.

Derived channels

Derived channels contain calculated data based on data from measured channels. In the Derived Channels section of the Preferences dialog box, you can choose additional channels derived from measured channels. You can also set the salinity, pressure, and temperature values used to calculate the derived channels when a sensor is not available.

Derived channels are included by default in the Plot view and in datasets.

Add depth as a derived channel

If your logger has a pressure channel, you can use its measurements to derive a depth channel. The data calculated for this derived channel appears along with measured channels in the Plot view and in datasets.

Steps

1. From the Options menu, click **Preferences**.

2. In the list on the left side of the Preferences dialog box, click **Derived Channels**.

3. On the Depth tab, select the **Enable Depth Channel** check box.

4. In the **Atmospheric Pressure** box, type a deciBar value for the atmospheric pressure on the logger or use the default value.

   This value corrects the pressure measurements during the depth calculation.

5. Click either **Simplified calculation** or **Seawater calculation**, which is a calculation based on a UNESCO technical paper:

   - If you want to use the simplified calculation, type the actual water density or use the default value. Note that for freshwater, the density should be set to 1.0.

   - If you want to use the UNESCO seawater calculation, specify the latitude of the data collection in degrees and minutes.

Add derived channels related to conductivity

If your logger has a conductivity channel, you can use its measurements to derive channels for salinity and speed of sound. The data calculated for these derived channels appears along with measured channels in the Plot view and in datasets.

Steps

1. From the Options menu, click **Preferences**.

2. In the list on the left side of the Preferences dialog box, click **Derived Channels**.

3. Click the **Conductivity – Salinity tab**.

If you want to apply a correction to the raw conductivity measurements for temperature and pressure changes, do the following:

- Select the Use conductivity correction check box.
- Type a value for hydrostatic pressure or use the default value for use when no pressure sensor is available.
- Ruskin uses the following equation:

$Ccorr = (C_m – b(T-T_c)) / (1+ a(T-T_c) + cP)$

Where C_{cor} is the corrected conductivity

C_m is the measured conductivity

T is the temperature

P is the hydrostatic pressure

a, b, T_c and c are experimentally determined constants and are labeled in Ruskin as C1, C2 , C3 and C4 respectively.

a is a function of the coefficient of linear expansion of the ceramic centre of the conductivity sensor

b is a function of the zero drift of the conductivity sensor as a function of temperature

T_c is the principal calibration temperature of the conductivity sensor

c is a coefficient which defines the pressure sensitivity of the conductivity sensor

4. If you want to derive a salinity channel using any XR-420/620-CT/CTD logger, select the **Density anomaly (kg/m3)** check box.

   Ruskin applies a correction to the density measurements that is calculated based on the UNESCO Technical Paper in Marine Science #44.

5. If you want to derive the specific conductivity for any XR-420/620-CT/CTD logger, under Specific Conductivity, select the **Corrected at 25°C** check box.

Ruskin calculates the Specific Conductivity from Standard Methods for the Examination of Water and Wastewater (1989) Ch. 2, L. S. Clesceri et al Eds., American Public Health Association, Washington D.C., 17th Ed.

6. If you want to calculate salinity using any XR-420/620-CT/CTD logger, under Salinity, select the **Practical Salinity Scale** check box.

7. If you want to calculate the speed of sound using any XR-420/620-CT/CTD logger, under Speed of Sound, select the formula that you want to use, one of UNESCO, del Grosso, or Wilson.

Add dissolved oxygen as a derived channel

You can derive a dissolved oxygen channel that measures the oxygen saturation as a percentage. The data calculated for this derived channel appears along with measured channels in the Plot view and in datasets.

Steps

1. From the Options menu, click **Preferences**.

2. In the list on the left side of the Preferences dialog box, click **Derived Channels**.

3. Click the **Dissolved O2** tab and select the **Enable Dissolved Oxygen Channel** check box.

4. If any of your loggers use the Oxyguard DO sensor to measure oxygen saturation and you want to use the Weiss equation, select the **Calculate concentration using the Weiss equation** check box and select the output unit, one of µMol/l, mg/l or ml/l.

   The Weiss equation requires values for temperature and salinity. If your logger does not measure these things, you can specify standard values on the No sensor values tab.

5. If any of your loggers use the Aanderaa Optode DO sensor to measure oxygen concentration, select the **Calculate concentration** check box and select the output unit, either mg/l or ml/l.

6. If any of your loggers use the Aanderaa Optode DO sensor to measure oxygen saturation, select the **Calculate saturation using the Garcia and Gordon equation** check box.

   The Garcia and Gordon equation requires values for temperature and salinity. If your logger does not measure these things, you can specify standard values on the No sensor values tab.

Calculate derived channels when sensors are missing

When your sensors do not provide the salinity, pressure, or temperature values needed to calculate derived channels, you can specify actual values to use instead.

Steps

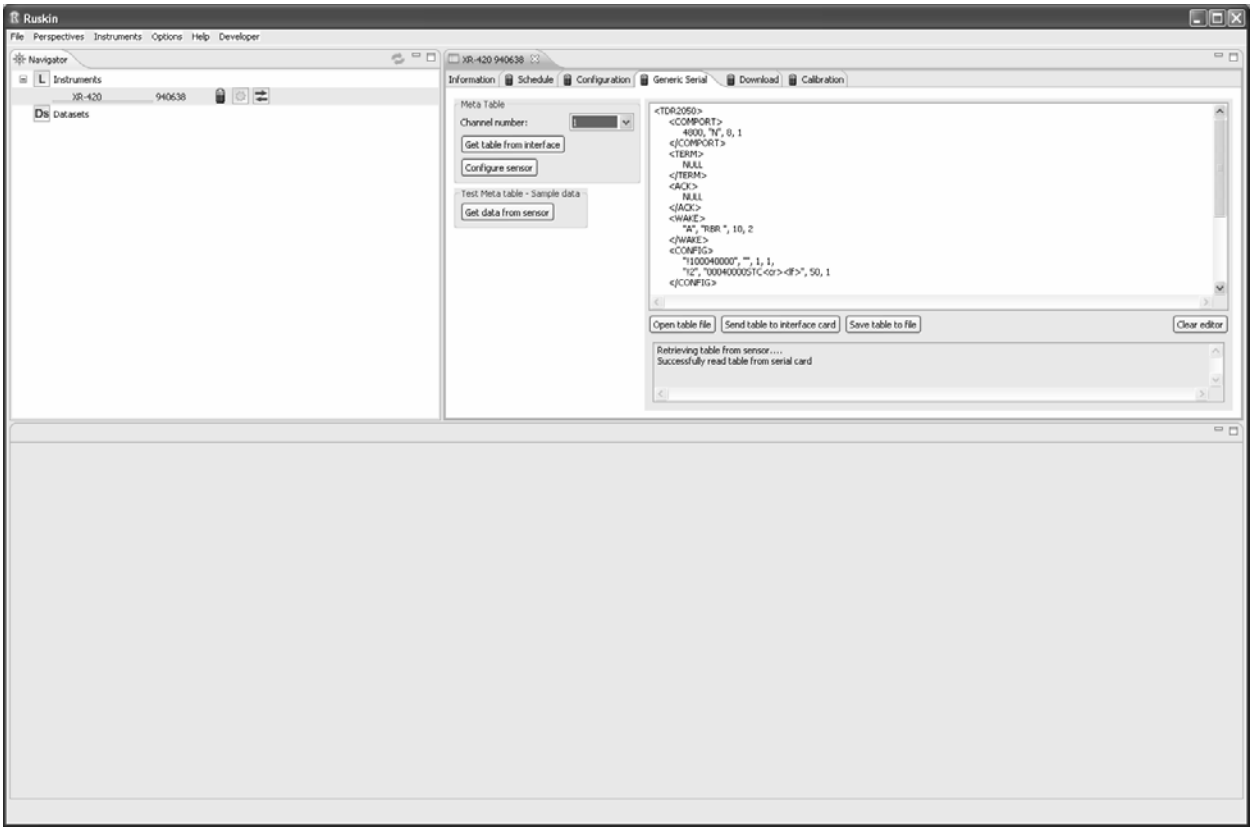
1. From the Options menu, click **Preferences**.
2. In the list on the left side of the Preferences dialog box, click Derived Channels.
3. Click the No sensor values tab.
4. In the boxes provided, specify the values that you want to use when actual values are not provided by your sensors.

Generic Serial Card - Meta table

More complex sensors that use serial interfaces are integrated in the logger through an RBR generic serial card. Each serial card must be configured for the particular sensor using a meta table. Meta tables are set at RBR Ltd. before delivery. However, it may be necessary to change the meta table in the field and this tab allows the meta table to be viewed, edited and sent to the generic serial card.

Ruskin detects whether logger is equipped with one or more serial cards and displays the Generic Serial tab in the Editor View. If the Generic Serial tab does not appear, it means that there is no serial card present.

The Generic Serial tab is divided into three areas: Meta Table, Test Meta table-Sample data and the Editor.



Meta Table

Channel number
If there is more than one serial card in the logger you can select the appropriate card by selecting the correct channel number from the drop down list.

Get table from interface
Pressing this button retrieves the current meta table stored in the card and displays it in the Editor area.

Configure sensor
Pressing this button loads the configuration in the meta table into the sensor.

Test Meta Table – Sample data

Get data from sensor
Pressing this button sends a command to all sensors asking them to perform a reading immediately. The resulting data is displayed in the Editor area.

Editor Area

In the editor area the meta table is displayed and can be edited. Messages are displayed from the application in a status box under the editor which indicate the success or failure of reading and writing meta tables.

Open table file
Pressing this button opens a browser that allows you to select the appropriate meta table file to display in the Editor area.

Send table to interface card
Pressing this button sends everything that is in the View and Edit area to the serial card (channel number) selected. Be careful when sending meta tables to the card to ensure you do not send unintended information to the card. To ensure that only the correct meta table is sent, press the clear editor button and open the table file again. The meta table is sent to the serial interface card and the sensor is configured at this time.

Save table to file
Pressing this button displays a browser which allows you to name and save all the data in the Editor area. If you want to save the meta table in the selected serial card, press clear editor, select get table from interface and then save table to file.

Clear editor
Pressing this button removes all the data from the Editor area.

Note: There is no capability to perform a live plot for loggers with a generic serial card.

Logger Hardware

Basic operating instructions

Introduction

This section of the manual covers the basic operation of RBR's submersible data loggers: changing the battery, inspecting and replacing O-rings, etc. Please see the Ruskin User Guide section of this manual for instructions relating to logger programming and data retrieval. This manual can also be found on the distribution CD and on RBR's website (www.rbr-global.com).

Opening and closing the logger

Note: Do not touch the circuit boards; moisture or even fingerprints can affect the accuracy of the logger. The exposed logger should be held by its sides.

1050 and 2050 series loggers

To open the TR-1050, DR-1050 or any of the 2050 family of loggers, unscrew the sensor end counter-clockwise. The end cap does not unscrew completely until the O-ring is clear of its mating surface in the body. This ensures that it will not eject at high speed should the interior of the logger become pressurised.

Carefully draw the end cap away from the body, sliding the attached inner assembly out of the case.

XR loggers

XR series loggers have two end caps: the sensor end cap houses the sensors, and the battery end cap covers the data port and battery carousel. Plastic loggers have a 6mm mooring line hole through the battery end cap. Titanium versions have a larger mooring line hole through a cylindrical protrusion out of the battery end cap.

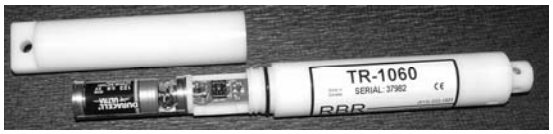
Access to the data port and the battery carousel is gained by removing the end cap opposite the sensor end of the logger. It may be unscrewed by hand or by using a rod inserted into the mooring line hole for leverage. The end cap does not unscrew completely until the O-ring is clear of its mating surface in the body. This ensures that it will not eject at high speed should the interior of the logger become pressurized.

The battery carousel is fastened to the assembly by a bolt through its centre. The carousel may be removed by twisting the bolt counter-clockwise until it is free.

Access to the inner assembly may be obtained by unscrewing the sensor end cap. Both the battery end cap and the battery carousel must be removed prior to unscrewing the sensor end cap. Damage to the back plane will result if the wrong end of the logger is opened first.

Closing the logger is exactly the reverse of opening it. Remember to keep the O-rings clean and avoid scratching the O-ring mating surfaces. Carefully inspect the O-rings, as described in the Inspecting the O-rings section (p.10), before deploying the logger. Do not use excessive force when tightening the end cap; hand-tight is quite sufficient, as the seal depends upon the O-rings, not the end cap tightness.

TR-1060 loggers



To open the TR-1060 loggers, turn the logger counter-clockwise from the middle (Warning: do NOT try to open the logger from the sensor end, which will break the circuit card). When the logger is disassembled, handle only the logger case. The logger case does not unscrew completely until the O-ring is clear of its mating surface in the body. This ensures that it will not eject at high speed should the interior of the logger become pressurized. Carefully slide out the half logger case with the inner assembly and battery holder.

Note: Do **NOT** turn the TR-1060 logger from the sensor end, which will break the circuit board.

Changing the batteries

For a discussion of battery life expectancy, please refer to Appendix A - Battery lifetime calculation on page 52.

RBR data loggers are powered by 2/3A size 3V lithium cells. These are standard camera batteries, and may be obtained from retail photographic or hardware outlets (see the following chart for model numbers).

Energizer	Kodak	IEC	Procell	Duracell	Rayovac	Panasonic	Varta
EL123A	K123LA	CR17345	PL123A	DL123A	RL123A	CR123A	CR123A

Before changing the batteries, ensure that the logger is not sampling and leave it idle for at least one minute after disconnecting it from the computer. This will ensure that it has entered its standby state and its operation will not be disturbed by removing the old batteries.

Important: RBR data loggers do not have a backup battery. If the logger has entered its standby state, the clock can run for approximately two minutes without batteries; however, it will almost certainly lose a significant amount of time. It is also quite possible that the clock will reset. **We strongly suggest that the logger be programmed <u>after</u> the batteries have been changed.**

1050 and 2050 series loggers

To remove the batteries, first open the logger. The batteries are held within their casing by the force of a single spring. Press firmly upon the negative end of the battery furthest from the spring and pull it out of the casing.

XR loggers

To remove the batteries, first open the logger and remove the battery carousel. The batteries can easily be slid out of the carousel.

When inserting new batteries, ensure that they are correctly oriented; the yellow "+" markings at the end of the battery carousel indicate the direction towards which the positive terminal of the battery should be placed. The logger will not work if the batteries have been inserted improperly.

TR-1060 loggers

To remove the battery, first open the logger. The battery is held within its casing by the force of a single spring. Press firmly upon the negative end of the battery farthest from the spring and pull it out of the casing.

When inserting a new battery, ensure that it is correctly oriented. The positive terminal of the battery should be placed toward the spring; the "+" marking on the bottom of the battery carousel indicates this direction. The logger will not work if the batteries have been inserted improperly.

Communicating with the logger

1050/2050 and XR series loggers

Using the internal data port

To establish a link between the logger and a computer, open the logger and locate the RJ-11 jack mounted at the end opposite the sensor(s). The supplied RS232 cable has two sizes of plugs. The narrower plug goes into the logger. The other plug fits into the serial port adapter, which then should be plugged into a 9 pin serial port on your computer.

If your computer does not have an available serial port, but does have a USB port, a serial to USB adapter may be used. Simply fit the serial connector into the serial to USB adapter and plug the adapter into the USB port on the computer.

Please note that the USB adapter's drivers must be installed before it will work.

Using an underwater connector

Some loggers are equipped with an Impulse MSSJ series underwater connector. This connector makes it possible to program and retrieve data from the logger while it is underwater. Please refer to the Real-time display section of the manual on page 18 for more information about live data collection.

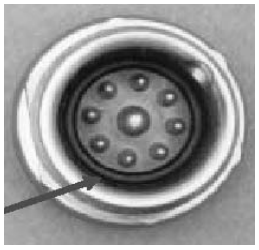
An optional RS485 interface allows for use of cables over 1km long.

To establish a connection, press the cable plug into the bulkhead receptacle and tighten the stainless steel connector. Please see the note below for precautions regarding the O-rings. O-ring specifications may be found in Appendix B on page 53.

Note:

The seal for the underwater connection depends upon two O-rings: one is attached to the connector and the other to the bulkhead. There are two common difficulties relating to these O-rings:

1. If the O-ring on the plug is not well greased, then the alignment recess can cut the O-ring. Greasing the O-ring before connecting the plug to the socket will prevent this from happening.
2. The O-ring at the bottom of the receptacle is easily lost. It is specially made for Impulse and has a non-standard size. Replacements may be obtained, but the cost is nearly five times that of a standard O-ring of similar size. Do not lose this O-ring. If you do, contact RBR for a replacement.



Recent loggers are equipped with IE55 connectors and the following guidelines are provided:

Lubricate mating surfaces with 3M Silicone Spray or equivalent. DO NOT GREASE. Connectors must be lubricated on a regular basis.

IE55-1200 contact surfaces must be dry prior to mating.

Lubricate O-rings with Dow Corning #111 Valve Lubricant or equivalent.

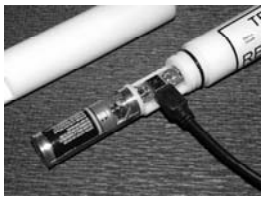
Keep O-ring grooves clean and avoid cuts and nicks in the O-ring. Replace O-rings when re-mounting connectors.

Avoid contact with solvents.

Avoid sharp bends at cable entry to connector.

Elastomers can be seriously degraded if exposed to direct sunlight or high ozone levels for extended periods of time.

TR-1060 loggers



To establish a link between the logger and a computer, open the logger and locate the data port mounted in the middle part of the inner assembly adjacent to the battery holder. The supplied RS232 cable has two sizes of plugs. The narrower plug goes into the logger connector. The other plug fits into the 9-pin serial port on your computer.

If your computer does not have an available serial port, but does have a USB port, a serial to USB adapter may be used. Simply fit the serial connector end into the serial to USB adapter and plug the adapter into the USB port on the computer.

Please note that the USB adapter's drivers must be installed before it will work.

Deployment

Once you have ensured that the batteries are fresh, inspected the O-rings and programmed the logger (see Configuration and Scheduling operation on page 6 for programming instructions), the instrument is ready to be deployed. There are three precautions you should take to avoid damaging the logger:

1. Heed the maximum pressure rating. All RBR loggers with pressure sensors are individually rated to a maximum depth/pressure. This is indicated by the label which is placed on the logger's sensor end cap. Loggers which do not have a pressure sensor do not have this label, but are limited by the maximum depth/pressure rating of either the logger housing itself or of the sensors.

2. Avoid physical stress to the logger. Any type of clamp or bracket which introduces pointed stress to the logger body is not recommended for use in logger mooring, mounting, and/or other deployment. Stress due to improper mounting may cause the logger to leak, resulting in the loss of valuable data or permanent damage to the electronics. RBR can provide proper mooring and mounting clamps suited to your specific application.

3. Use desiccant when necessary. If the logger is closed up in a hotter, more humid environment than the deployment environment, internal condensation can result. Since condensation may cause the circuitry to malfunction, it is advised under these circumstances that you contact RBR for an application specific solution; this may involve the installation of desiccant prior to deployment.

Maintenance and repairs

Support kits

To simplify maintenance of your data logger, RBR sells Support kits with enough O-rings, and silicone grease for 5 deployments. Please contact RBR for more information or to place an order.

O-rings

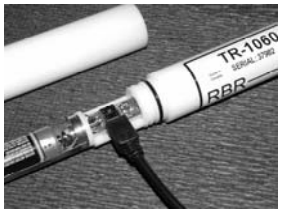
The single most important item of maintenance on any RBR submersible data logger is care of the O-rings. Any kind of water leak can damage the circuitry beyond repair and cause complete data loss. Every logger's seal depends upon its O-rings, not the end cap tightness. Proper O-ring maintenance, therefore, is crucial.

Please see Appendix B on page 53 for O-ring specifications for each logger.

Important: O-rings may lose elasticity over time due to pressure, even when the logger is not deployed. **We strongly suggest that the O-rings be replaced regularly, e.g. before every deployment, or after change of batteries, or at least once a year.**

Inspecting O-rings

O-ring on 1050/2050 and XR loggers



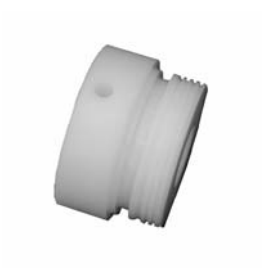
O-ring on TR-1060 loggers

O-rings must be undamaged and the mating surfaces free from particles of grit, hair or small scratches in order to preserve a seal. Before deploying the logger, carefully inspect the O-rings that are required to maintain a seal. 1050/2050 series loggers depend upon one O-ring in the end cap. The plastic XR series of loggers have one O-ring for each end cap and two for each detachable sensor. Titanium versions of the XR series loggers have a backup ring in each end cap as well. TR-1060 loggers have one O-ring seated in the middle part of the logger case.

Give particular attention to the following areas:

- The surface of the O-ring itself

- The mating surface on the inside of the case between the threads and the open end
- The inner surfaces of the groove in the end cap where the O-ring sits
- The mating surfaces for each removable sensor
- The underwater connector for external power or data transfer (if used)



Any dirt present should be removed by wiping thoroughly with a soft, lint-free cloth. When cleaning, never use any material or tool which could scratch the O-ring or any of its mating surfaces. If any dirt is present in the O-ring groove, then the O-ring should be removed as described below to allow thorough cleaning of the groove. If an O-ring needs to be removed for any reason, it should be replaced.

If the O-ring is scratched, cut, distorted, perished or defective in any other way it must be replaced. If any of the surfaces of the O-ring groove are scratched, pitted or otherwise damaged, the logger may need to be returned to RBR for refurbishment: please contact us for advice.

Replacing an O-ring

1) Lever the O-ring from its groove. Use a soft plastic or wood tool; do not use a metal screwdriver or any other tool which may scratch the surfaces of the O-ring groove: doing so will probably render the end cap useless. Slide the O-ring out of its groove and off the logger. The O-ring may need to stretch quite a bit as it is pushed off; this requires some effort but can be done by hand.

2) Thoroughly clean the O-ring groove, taking great care not to scratch or damage it in any way. Inspect it carefully, and contact us for advice if it appears damaged. Apply a light film of silicone grease to all three inside surfaces of the groove, being careful not to trap any dirt, hairs or lint.

3) Select the proper O-ring (consult Appendix B on page 53 for O-ring sizes) and make sure it is not damaged. Lubricate it with a very light film of silicone grease to ease its installation.

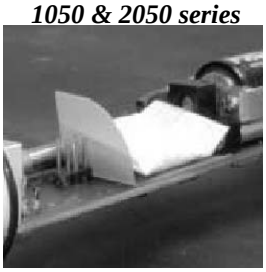
4) Install the new O-ring by pushing it into place and popping it into its groove. The O-ring may need to stretch quite a bit as it is pushed on; this requires some effort but can be done by hand.

5) When the new O-ring is in place, inspect it once more for scratches and dirt, and wipe away any silicone grease deposited on the end cap.

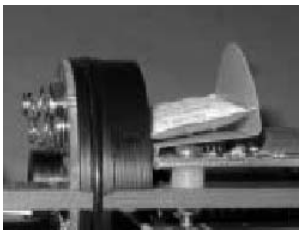
Most experienced users of oceanographic equipment replace all O-rings before every deployment as a matter or routine. The cost of an O-ring is negligible compared with the cost of the instrument and its deployment. Routine replacement of O-rings, therefore, is cheap insurance.

Drying agent

1050 & 2050 series



XR series



TR-1060 loggers

If the logger is closed up in a hotter, more humid environment than the deployment environment and then plunged into cold water, internal condensation can result. Since condensation may cause the circuitry to malfunction, it is advised in such circumstances that, after the logger is set up and before it is closed for deployment, a small pack of desiccant be placed on the battery side of the circuit board above the battery mount.

A desiccant plastic “pocket” should be installed before adding a desi-pack. The pocket is an L-shaped piece of plastic designed to keep any moisture absorbed by the desi-pack off the electronics.

If your application requires desiccant, please contact RBR for more information.

Repairs

We support all instruments and software that we manufacture. First line support is always available by phone, fax or e-mail. Please contact us immediately if you are experiencing problems with your RBR product. It is very important to contact us before returning your instrument, as some difficulties can be easily solved on-site by the user. Please have the model and serial number of the unit handy when you contact us.

There are no user-repairable parts of the logger. Any attempt at repair, whether successful or not, without prior authorization from RBR Ltd. will void the warranty.

If it is necessary to return the product to RBR for an upgrade, repair, or calibration; please review the detailed shipping information on our website before returning the unit.

Calibration

We recommend that you verify the calibration of your data logger before any critical deployment, periodically once a year, or if you suspect the calibration to be out of specifications. Discuss your calibration needs with RBR. In some cases, you will be recommended to return the instrument to RBR to have it checked and re-calibrated. Please contact us for our current calibration fees

Appendix A – Battery life calculation

When to replace the batteries

Compared to the cost of deployment, the cost of a new set of batteries is close to negligible. We highly recommend that the batteries be replaced before every deployment unless there is no doubt that they have sufficient capacity.

Battery voltage does not decrease linearly and is therefore not an accurate indicator of battery capacity. However, if the logger software indicates that the batteries have less than 12V remaining (6V for single channel loggers), the batteries should be replaced.

When in doubt, replace the batteries.

Predicting battery life

Battery life prediction is a complicated issue. In RBR loggers, battery life is a strong function of the type of logger, the type and number of sensors attached, the sampling scheme (sampling period and the use of: thresholding, real-time data collection and averaging), and the temperature of the water during the deployment. Manufacturers' data for the batteries do not provide information that can be directly related to way the batteries are used in RBR Loggers.

The Ruskin Software calculates the expected battery usage (in mA Hours - mAh) for the logger during setup, see Ruskin User Guide. The nominal capacity of the batteries is 1300mAh at room temperature. The software will warn the user if the expected battery usage for a particular deployment scenario is above 1000mAh. The software will not prevent a logger from being started even if a warning is given. In tests at RBR Ltd. of multiple examples of various brands of batteries at 6°C, all examples were able to provide the threshold capacity of 1000mAh. The user should view these predictions and further de-rate the batteries if the expected deployment is in cold water. The battery usage estimate is stored as part of the log files and may be used after deployment to enable the user to obtain a characterization of how a particular logger performs.

RBR continues to characterize battery life in its loggers and will continue to improve the battery life calculator in future versions of the Ruskin Software.

Battery life will be reduced if the RS485 serial transmission protocol is employed. The consumption for the RS485 driver is defined as 2.5mA nominal. Hence for every hour of deployment, 2.5mAh must be added to the battery drain figures.

Appendix B – O-ring specifications

Each 1050 or 2050 series logger has one user replaceable O-ring located above the thread of its end cap. Titanium versions also have a backup ring in the same groove.

XR series loggers have one user replaceable O-ring located in each end cap above the thread. Titanium versions also have a backup ring with each O-ring in the same groove.

TR-1060 loggers have one O-ring seated in the middle part of the logger case.

***Important*: We strongly suggest that the O-rings be replaced regularly, e.g. before every deployment, or after change of batteries, or at least once a year.**

1050 and 2050 series loggers - Plastic

End cap O-ring:	#2-214 N70

1050 and 2050 series loggers - Titanium

End cap O-ring:	#2-214 N70
Backup ring:	#8-214 N90

XR Series - Plastic

End cap O-rings:	#2-225 N70

XR Series - Titanium

End cap O-rings:	#2-225 N70
Backup rings:	#8-225 N90

TR-1060 loggers - Plastic

O-ring:	#2-018 N70

Impulse MSSJ underwater connector

Bulkhead	#5-058 N70 (non-standard, contact RBR for replacements)
Plug	#2-013 N70

See page 49 for more details

Impulse IEE55 underwater connector

No O-rings are required

Appendix C – Event and Error Stamps

The following is a list of event/error stamps that may be displayed in the data set.

TIM - Time synchronization event
STP - Stop sampling event
GAN - Gain change event
CHG - Change event (system restart where logger clock is no longer valid)
WRM - Warm startup event (clock and programmed parameters are valid/unharmed)
REC - Recovery event (problem with Real time clock. Logger attempts to fix the time but it may not be accurate)
BST - Burst event (for waves)
RTC - Real Time Clock change event
LUK - Cool startup event (some programmed parameters may not be valid)
CLD - Cold startup (startup from a complete power down)
TTY - Communication problem event
SER - Serial error (XR 620/420, problem communicating between micro computer and sensor card)

Below is a description of all the different event stamp types ***xxx*** which could be encountered. Some of these are quite common, while others indicate very rare fault conditions. Some may also occur together in various combinations, with no sample data between them.

TIM is used to ensure timing synchronization, whenever there is a possibility that the actual date/time of a sample according to the logger's internal calendar/clock does not match what is expected in the normal sampling sequence.

STP is used to indicate that a command to stop sampling occurred.

GAN is used to indicate that a sensor has changed its gain setting – typically occurs with auto-ranging fluorometers and turbidity sensors.

CHG is used to indicate a system restart, in which all programmed parameters are valid, but the date/time in the internal real time clock was not. This may typically occur after interruption of power to the logger; for example, if the batteries are changed.

WRM indicates a system restart, in which all programmed parameters are valid, and so is the date/time in the internal real time clock. This may occur in response to some electrical disturbance which resets the logger's CPU, but does not affect it otherwise;

this can include very brief interruption of battery power due to mechanical shock or vibration.

REC may accompany a **CHG** timestamp if the logger's non-volatile status indicates that it should be sampling. The date/time in the logger's real time clock is corrupted, but the logger makes an attempt to reconstruct a valid setting as nearly as possible, using data already recorded in the memory. The result will not be exactly correct, but at least allows the logger to continue collecting data, while the timestamp alerts the user to a possible problem with the sample times. It may later be possible to reconstruct the true sample times by correlating the data with an external influence at a known time

There is also an event stamp which routinely appears in user data, but only in a TWR data logger which is used for recording wave bursts.

BST indicates the start of a recorded wave burst in a TWR data logger. Wave bursts are a special case, with some differences when compared to other stored data. Each individual reading is still stored as a 3-byte, 24-bit number, with the most significant byte first. However, there is not a reading from every channel in the logger within the burst; a burst contains *only* readings from the pressure channel. The number of readings present will be the wave burst length. The time between the readings within the burst is determined by the wave burst sampling rate.

The wave burst is usually followed by a timestamp to ensure synchronization of the following data. This will typically be for tidal averages, in which the stored data reverts to its normal format of one reading per channel, until another wave burst occurs.

The remaining timestamp types are much less common, and may be associated with one of a number of rare faults or unusual situations.

RTC shows that the RTC date/time was changed, in a way which may affect the sample time sequence. It is always accompanied by **TIM** timestamps showing the date/time both before and after the change was made, and a synchronizing timestamp with the sample data if necessary. This is not commonly seen, because RBR software does not permit date/time changes while the logger is sampling.

LUK indicates a system restart, in which the internal real time clock contained a valid date/time, but one or more of the programmed parameters was not valid. Non-volatile storage of the programmed parameters is normally very robust, and this is not a common occurrence.

CLD indicates a complete system restart; neither the internal real time clock setting nor the programmed parameter values were valid. This usually occurs only in instruments which are brand new or which have been reprogrammed or reconfigured, and is not normally seen outside the RBR factory.

TTY indicates a serious failure of communication with the host, in which the logger was unable to send data over the serial connection because of an internal problem, although it may be able to recover later. This is very rare.

SER can occur only in an XR-420 or XR-620, and indicates a serious failure of communication between the CPU and one or more of the internal sensor modules. Again, the logger may be able to recover subsequently, and the fault is very rare.